

In the Office Action mailed July 17, 2002, claims 1-20 were finally rejected under 35 U.S.C. §103(a) as being unpatentable over Hartley et al., U.S. Patent No. 4,853,737 ("Hartley"), and incorporated by reference, Lentz, U.S. Patent No. 4,257,699 ("Lentz"), in view of Schlueter, Jr. et al., U.S. Patent No. 5,995,796 ("Schlueter"). Also, claims 1-22 were finally rejected under 35 U.S.C. §103(a) as being unpatentable over Hartley in view of Schlueter and Blong et al., U.S. Patent No. 5,527,858 ("Blong").

In the September 19, 2002 Advisory Action, it was stated that "...the features upon which applicant relies (i.e., excellent release characteristics due to very low surface energy) are not recited in the rejected claim(s)." The applicants acknowledge that "excellent release characteristics" and "low surface energy" are not recited in the claims but respectfully disagree with the assertion that they rely on these features. In their response filed September 5, 2002, the applicants explained that fluorocarbon elastomers and fluorocarbon thermoplastics are well recognized as distinctly different materials, with separate entries in different volumes of the *Encyclopedia of Polymer Science and Engineering*. The applicants further noted that these materials are characterized by substantially different physical properties, for example, surface energies (high for fluoroelastomers, low for fluoroplastics), glass transition temperatures (applicable to fluoroelastomers), and melting ranges (applicable to fluoroplastics).

Also in the Advisory Action, the Examiner stated that the fluoroelastomers of Hartley are polymers comprising pendant polydiorganosiloxane covalently bonded to a thermoplastic VF-HFP-PTFE terpolymer backbone and further asserted that the Hartley fluoroelastomers are, in fact, fluorocarbon thermoplastic random copolymers, as claimed in the instant application. The applicants acknowledge that the fluoroelastomers of Hartley contain pendant polydiorganosiloxane covalently bonded to a polymeric backbone. However they respectfully disagree with the Examiner's assertion that this backbone is thermoplastic and that the disclosed fluoropolymers are therefore fluorocarbon thermoplastic random copolymers. Hartley teaches a fluoroelastomer base polymer such as Viton A or Viton B (column 2, line 29, to column 3, line 4), to which is covalently bonded a small amount of polydiorganosiloxane segments (column 4, line 40, to column 5, line 66), thereby providing an "internal lubricant" that results in a relatively low surface energy coating (column 4, lines 40-52).

In contrast to the instant specification, Hartley does not recite percentage ranges for the monomers comprising the disclosed fluoroelastomers, i.e., Viton A, a VF-HFP copolymer, and Viton B, a VF-HFP-TFE terpolymer. The Examiner, citing the disclosure of Eddy et al., U.S. Patent No. 5,017,432 ("Eddy") at column 6, lines 4-6, that the terpolymer Viton B contains 61% VF, 17% HFP, and 22% TFE, alleges that, because these amounts fall within the monomer ranges recited for the thermoplastic fluoropolymers in the instant specification, the fluoropolymers of Hartley, specifically Viton B, must also be thermoplastic. However Eddy, at column 2, line 66 to column 3, line 6, and column 3, lines 17-26, clearly refers to Viton polymers, including Viton B, as elastomers. Incidentally, the compositions described in Examples 1 and 2 of Hartley both contain 100 parts of the VF-HFP copolymer Viton A and 5 parts of an amino-terminated polydimethylsiloxane oligomer. Hartley repeatedly and consistently refers to the disclosed compositions as fluoroelastomers and further frequently refers to the fluoroelastomer "backbone" (for example, column 3, lines 24-29; column 4, line 60; column 8, lines 25-26). As shown in the three-page enclosure entitled "Comparison of DuPont Dow Viton® Fluoroelastomers", there are three general use grades of Viton fluoroelastomers, A being a VF-HFP copolymer, B and G being VF-HFP-TFE terpolymers.

In support of her assertion that the fluoropolymers of Hartley are thermoplastic polymers, the Examiner in the Advisory Action cited the disclosures of Vaia et al., U.S. Patent No. 6,225,374 ("Vaia") and Schiffman et al., U.S. Patent No. 6,203,873 ("Schiffman"). Vaia, which has to do with a solvent-free method of forming a silicate-polymer composite, is cited simply for its mention of polydimethylsiloxanes as an example of thermoplastic polymers. The second cited reference, Schiffman, is more relevant to the present case. Schiffman discloses a blend of a first fluorinterpolymer having elastomeric characteristics and a second fluorinterpolymer having thermoplastic characteristics (column 1, lines 46-48). Schiffman further discloses that the first fluorinterpolymer having elastomeric characteristics and the second fluorinterpolymer having thermoplastic characteristics each comprises a copolymer, terpolymer, or mixture thereof formed by the copolymerization of two or more monomers selected from the group consisting of HFP, VF, and TFE (column 1, line 57 to column 2, line 5). Thus, both the elastomeric and the thermoplastic fluorinterpolymers taught by Schiffman are formed from the same group of three

monomers, which also constitute the fluorocarbon thermoplastic random copolymer constituting the coating composition of the present invention.

The applicants therefore maintain their position that their fuser roll release layer is formed from a fluorocarbon thermoplastic random copolymer, in contrast to Hartley, Lentz, and Schlueter, all of which teach fuser roll release layers formed from cured fluoroelastomers.

The Examiner has acknowledged that Hartley fails to teach the inclusion in the composition of antimony doped tin oxide, relying on Schlueter to supply this missing disclosure. As taught at page 11, line 28 to page 12, line 3 of the instant specification, the inclusion of antimony doped tin oxide particles is crucial for drastically lowering the curing temperature of the coated thermoplastic polymer, from 220 to 280°C to as low as room temperature (25°C). Hartley teaches curing temperatures of at least 230°C, and Lentz includes an example with a curing temperature of 232°C. There is no teaching in any of the cited references of a metal oxide or combination of oxides being used to enable low temperature curing of a fluoroelastomer layer.

As taught in the instant specification, high temperature curing of a fluoroelastomer release layer can cause damage to a fuser roll, for example, depolymerization of silicone rubber in the cushion layer. The method of the present invention advantageously provides for the curing of a layer formed from a fluorocarbon thermoplastic copolymer composition at a substantially lower temperature of 25°C to 120°C, preferably 25°C to 50°C, more preferably 25°C. This benefit is enabled by the inclusion of antimony-doped tin oxide particles in the coating composition.

As noted in the applicants' previous response, the compositions disclosed in Blong, in contrast to those of Hartley, Lentz and Schlueter, do include thermoplastic fluoropolymers. At column 1, lines 11-23, Blong refers to a relatively new class of commercially available fluoropolymers, which are thermoplastic terpolymers of TFE, HFP, and VF and are sold by the 3M Company as "3M THV fluoroplastics." In the illustrative examples in Blong, 3M THV 500 Fluoroplastic is employed (column 6, lines 33-37). The enclosed two data sheets for THV-400 and THV-500 fluoroplastics shows that these materials have high melting temperatures and are typically processed by extrusion at even higher temperatures.

As disclosed at page 12, line 25 to page 13, line 2 of the instant specification, the same materials that are disclosed in Blong are employed in the coating

compositions of the present invention, which can be cured at low temperatures. Blong, however, contains no teaching of a curing temperature, reciting instead an extrusion temperature of 230°C.

As already noted, the coating composition of the present invention comprises a fluorocarbon thermoplastic random copolymer having subunits of $-(CH_2 CF_2)_x-$, $-(CF_2 CF(CF_3))_y-$, and $-(CF_2 CF_2)_z-$, wherein x is from 1 to 50 or 60 to 80 mole percent, y is from 10 to 90 mole percent, z is from 10 to 90 mole percent, and $x + y + z$ equals 100 mole percent. This same fluorocarbon thermoplastic random copolymer having the same ranges of the three recited fluoromonomers is disclosed in the following issued patents:

U.S. 6,444,741
U.S. 6,429,249
U.S. 6,419,615
U.S. 6,416,819
U.S. 6,372,833
U.S. 6,361,829
U.S. 6,355,352

Hartley et al., U.S. 4,857,737 ("Hartley") is of record in all of these applications except U.S. 6,419,615.

In light of the foregoing discussion, withdrawal of the §103(a) final rejection of claims 1-22 and allowance of this case is again earnestly solicited.

Respectfully submitted,

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Date

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Enclosures

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Comparison of Dupont Dow Viton® Fluoroelastomers

There are three major general use grades of Viton® fluoroelastomer: A, B and F. They differ primarily in their resistance to fluids, and in particular aggressive lubricating oils and oxygenated fuels, such as methanol and ethanol automotive fuel blends. There is also a class of high performance Viton® grades: GB, GBL, GP, GLT, and GFLT.

General Use Grades:

Viton® A: (vinylidene fluoride and hexafluoropropylene)

Viton® A is a family of fluoroelastomer dipolymers, that is they are polymerized from two monomers, vinylidene fluoride (VF2) and hexafluoropropylene (HFP). Viton® A fluoroelastomers are general purpose types that are suited for general molded goods such as o-rings and v-rings, gaskets, and other simple and complex shapes. There is a full range of Viton® A grades that accommodate various manufacturing processes including transfer and injection molding, extrusion, compression molding, and calendaring.

Viton® B: (vinylidene, hexafluoropropylene and tetrafluoroethylene)

Viton® B is a grade of fluoroelastomer terpolymers, that is they are polymerized from three monomers, vinylidene (VF2), hexafluoropropylene (HFP), and tetrafluoroethylene (TFE). Viton® B

Viton grades; A fluoroelastomers, vinylidene fluoride, hexafluoropropylene

Page 2 of 3

fluoroelastomers offer better fluid resistance than A type fluoroelastomer. There is a full range of Viton® B grades that accommodate a variety of manufacturing processes including injection and compression molding, extrusion, and calendaring.

Viton® F:

Viton® F is a grade of fluoroelastomer terpolymers, that is they are polymerized from three monomers, vinyl fluoride (VF₂), hexafluoropropylene (HFP), and tetrafluoroethylene (TFE). Viton® F fluoroelastomers offer the best fluid resistance of all Viton® types. F types are particularly useful in applications requiring resistance to fuel permeation. There is a range of Viton® F grades to accommodate various manufacturing requirements.

High Performance Grade:

Viton® GB, GBL:

Viton® GB and GBL are grades of fluoroelastomer terpolymers, that is they are polymerized from three monomers, vinyl fluoride (VF₂), hexafluoropropylene (HFP), and tetrafluoroethylene (TFE). Viton® GB and GBL use peroxide cure chemistry that result in superior resistance to steam, acid, and aggressive engine oils. There is full range of GB and GBL types that can accommodate most rubber processing requirements including compression, injection and transfer molding, extrusion, and calendaring.

Viton® GLT:

Viton® GLT is a fluoroelastomer designed to retain the high heat and the chemical resistance of general use grades of Viton® fluoroelastomer, while improving the low temperature flexibility of the material. Glass transition temperatures (T_g) of materials are indicative of low temperature performance in typical elastomer applications. Viton® GLT shows an 8 to 12°C lower T_g than general use Viton® grades. There is a range of GLT products to accommodate various processing conditions.

Viton grades; A fluoroelastomers, vinylidene fluoride, hexafluoropropylene

Page 3 of 3

Viton® GFLT:

Viton® GFLT is a fluoroelastomer designed to retain the high heat and the superior chemical resistance of the GF High Performance types, while improving the low temperature performance of the material. Viton® GFLT shows a 6 to 10°C lower Tg than general use Viton® grades. There is a range of GFLT products to accommodate various processing conditions.

Key: 1=Excellent, 2=Very Good, 3=Good, NR=Not Recommended

Relative Chemical Compatibility and Mechanical Properties of Viton® Fluoroelastomers							
	Viton®—General Use Grade Types			Viton®—High-Performance Grade Types			
Chemical Environment	A	B	F	GB, GBL	GF	GLT	GFLT
Automotive and aviation fuels	1	1	1	1	1	1	1
Automotive fuels oxygenated with MEOH, ETOH, MTBE, etc.	NR	2	1	2	1	NR	1
Engine lubricating oil, SE and SF	2	1	1	1	1	1	1
Engine lubricating oil, SG and SH	3	2	1	1	1	2	1
Aliphatic hydrocarbon process fluids, chemicals	1	1	1	1	1	1	1
Aromatic hydrocarbon process fluids, chemicals	2	2	1	1	1	2	1
Aqueous fluids, steam, mineral acids	3	2	2	1	1	1	1
Compression and low-temperature performance							
Resistance to compression set	1	2	2	2	3	2	2
Low-temperature flexibility	2	2	3	2	3	1	1

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Glossary

Material Science

Overview

Characteristics

Comparisons

Selection Criteria

Applications

Flow Characteristics

Datasheet Primer

Major Categories

Polymer Index

History Timeline

List by Process

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Fluoroplastics

State: THV-400

Material Properties

Mechanical Properties

		State 1	State 2
Tensile Strength (MPa)	23	at break	
Elongation at break (%)	500		
Hardness	53	Shore	

Physical & Electrical Properties

	Cond State
Specific Gravity	1.97

Processing Properties

	Conditions Type
Melting Temperature (°C)	150 T _m , crystalline
Processing Temperature (°C)	243 extrusion

Suppliers

Dyneon

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General Information

Polymer Home

Glossary

Material Science

Overview

Characteristics

Comparisons

Selection Criteria

Applications

Flow Characteristics

Datasheet Primer

Major Categories

Polymer Index

History Timeline

List by Process

List by ThermoP/S

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Category / Grades

Datasheet

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Fluoroplastics

State: THV-500

Material Properties

Mechanical Properties

		State 1	State 2
Flexural Modulus (MPa)	207	23 °C	
Tensile Strength (MPa)	23	at break	
Elongation at break (%)	500		
Hardness	54	Shore	

Physical & Electrical Properties

	Cond State
Specific Gravity	1.78

Processing Properties

		Conditions Type
Melting Temperature (°C)	180	T _m crystalline
Processing Temperature (°C)	249	extrusion

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